

CLAIMS

What is claimed is:

1. A keel joint for retaining a riser within the keel of a floating vessel, the keel joint comprising:
a keel opening disposed generally vertically within a floating vessel;
a riser disposed within the keel opening; and
a limiting joint securing the riser with respect to the keel opening, the limiting joint precluding horizontal movement of the riser with respect to the keel opening, but permitting vertical and angular movement of the riser with respect to the keel opening.
2. The keel joint of claim 1 wherein the limiting joint comprises:
a generally cylindrical stiffening can that is disposed within the keel opening; and
a collar that annularly surrounds the riser and is secured to the stiffening can.
3. The keel joint of claim 1 wherein the limiting joint comprises:
a wear sleeve radially surrounding an outer portion of the riser;
an annular ring disposed upon the outer portion of the wear sleeve, the ring presenting a vertically curved outer surface;
an annular recess formed within the keel opening and presenting an inner surface that is generally complimentary to the curved outer surface of the annular ring, the annular recess retaining the annular ring therewithin to permit angular movement of the wear sleeve within the keel opening.
4. The keel joint of claim 3 wherein the wear sleeve and collar are run in with the riser.

5. The keel joint of claim 3 wherein the wear sleeve is seated within the keel opening using a seating profile.

6. The keel joint of claim 1 wherein the limiting joint comprises:

- a wear sleeve radially surrounding an outer portion of the riser;
- an annular ring disposed upon the outer portion of the wear sleeve, the ring presenting a frustoconical outer surface;
- an annular recess formed within the keel opening and presenting an inner surface that is generally complimentary to the frustoconical outer surface of the annular ring, the annular recess retaining the annular ring therewithin to permit angular movement of the wear sleeve within the keel opening.

7. The keel joint of claim 6 wherein the wear sleeve comprises a tapered portion that assists angular movement of the wear sleeve within the keel opening.

8. The keel joint of claim 6 wherein the keel opening further comprises an outwardly flared upper portion.

9. The keel joint of claim 1 wherein the limiting joint comprises at least one centralizer assembly disposed within the keel opening and in contact with the riser.

10. The keel joint of claim 9 wherein the centralizer assembly comprises a piston-type centralizer assembly.
11. The keel joint of claim 9 wherein the centralizer assembly comprises a hinged centralizer assembly.
12. The keel joint of claim 9 wherein the centralizer assembly is hydraulically-actuated.
13. The keel joint of claim 9 wherein the centralizer assembly is mechanically-actuated.
14. The keel joint of claim 1 wherein the limiting joint comprises:
 - a riser collar that radially surrounds a portion of the riser, the riser collar having a bulbous central portion; and
 - a guide sleeve secured within the keel opening to radially surround the riser collar, the guide sleeve comprising an interior rounded profile that is shaped and sized to receive the bulbous portion and permit angular rotation of the bulbous portion therewithin.
15. The keel joint of claim 14 wherein the guide sleeve and riser collar are run in with the riser.
16. The keel joint of claim 14 wherein the guide sleeve is seated within the keel opening using a seating profile.

17. The keel joint of claim 14 further comprising a locking flange that secures the position of the guide sleeve with respect to the keel opening.
18. The keel joint of claim 17 wherein the locking flange may be unlocked and retrieved by upward movement of the riser with respect to the guide sleeve.
19. The keel joint of claim 1 wherein the limiting joint comprises:
 - an inner, cylindrical riser sleeve that radially surrounds and engages the riser;
 - an outer, cylindrical keel sleeve that radially surrounds the riser sleeve and engages the keel opening; and
 - a cage formed of a plurality of flexible spokes that radiate from the riser sleeve to the keel sleeve, the spokes being elastically deformable as needed to accommodate angular movement of the riser with respect to the keel opening.
20. The keel joint of claim 19 further comprising a locking flange that secures the position of the guide sleeve with respect to the keel opening.
21. The keel joint of claim 20 wherein the locking flange may be unlocked and retrieved by upward movement of the riser with respect to the guide sleeve.
22. The keel joint of claim 1 wherein the limiting joint comprises:

an open top can riser section that is incorporated into said riser, the open top can riser section comprising:

an elongated, cylindrical inner tubular member having end connection means for connecting the inner tubular member to adjoining riser sections;

an outer tubular member that radially surrounds the inner tubular member and is secured within the keel opening; and

an annular flange adapter that interconnects the inner and outer tubular members.

23. A keel joint for retaining a riser within the keel of a floating vessel, the keel joint comprising:

a riser;

a substantially cylindrical stiffening can disposed within a keel of a floating vessel and radially surrounding the riser;

a single joint in contact with the can and the riser, the joint permitting angular movement of the riser with respect to the can; and

a plurality of supports extending from a keel of a floating vessel radially inwardly to contact the can, the supports being unaffixed to the can to permit upward and downward movement of the can within the keel of the floating vessel.

24. The keel joint of claim 23 wherein the joint comprises a pair of collars interconnect the can and riser.

25. The keel joint of claim 23 wherein the supports each present a rounded end for contacting the can.

26. The keel joint of claim 23 wherein the supports each present a roller for contacting the can.

27. A keel joint for retaining a riser within the keel of a floating vessel, the keel joint comprising:
a keel opening disposed generally vertically within a floating vessel;
a riser disposed within the keel opening; and
a limiting joint securing the riser with respect to the keel opening, the limiting joint precluding horizontal movement or the riser with respect to the keel opening, but permitting vertical and angular movement of the riser with respect to the keel opening, the limiting joint comprising:
a wear sleeve secured to the riser;
a stiffening can disposed radially within the keel opening; and
an annular member joining the wear sleeve to the stiffening can.

28. The keel joint of claim 27 wherein the annular member comprises a cage having a plurality of radially extending spokes.

29. The keel joint of claim 27 wherein the annular member comprises a collar.

30. The keel joint of claim 27 further comprising a plurality of supports extending radially inwardly from the keel opening to contact the stiffening can.